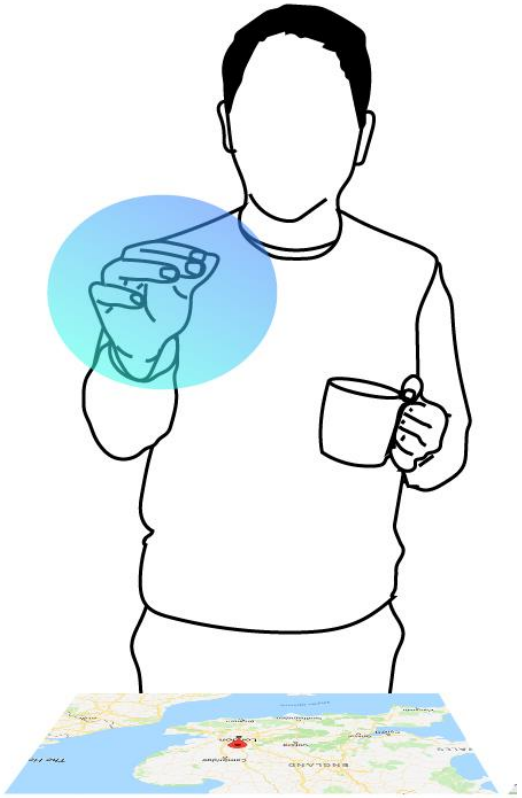


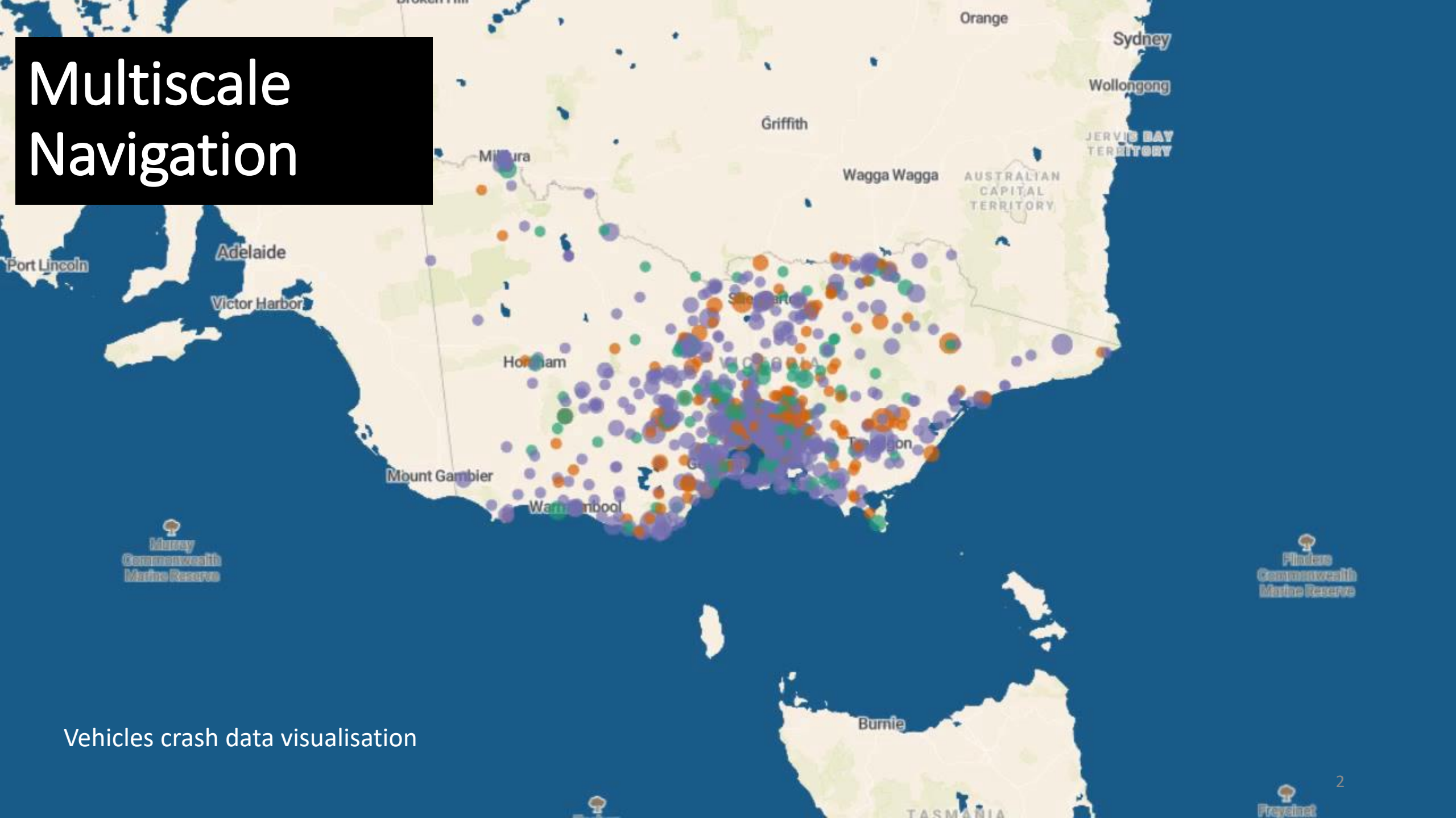
Augmented Reality Map Navigation with Freehand Gestures

Kadek Ananta Satriadi[1], Barrett Ens[1], Maxime Cordeil[1], Tobias Czauderna[1], Wesley Willet[2], Bernhard Jenny[1]

IA Lab
MONASH University[1]
UNIVERSITY OF CALGARY[2]

IEEE VR 2019 OSAKA

Multiscale Navigation

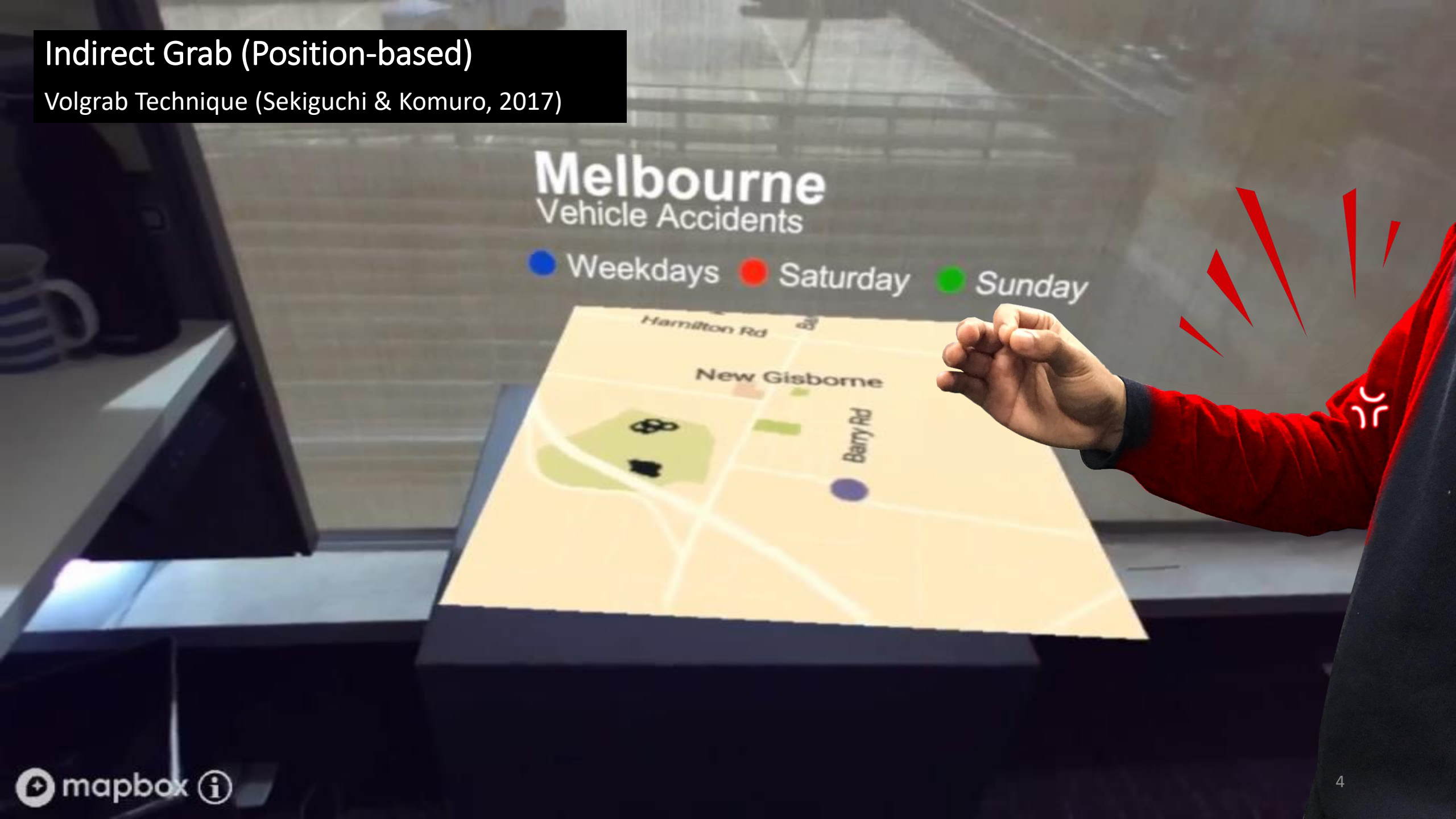


Vehicles crash data visualisation

Augmented reality map

Indirect Grab (Position-based)

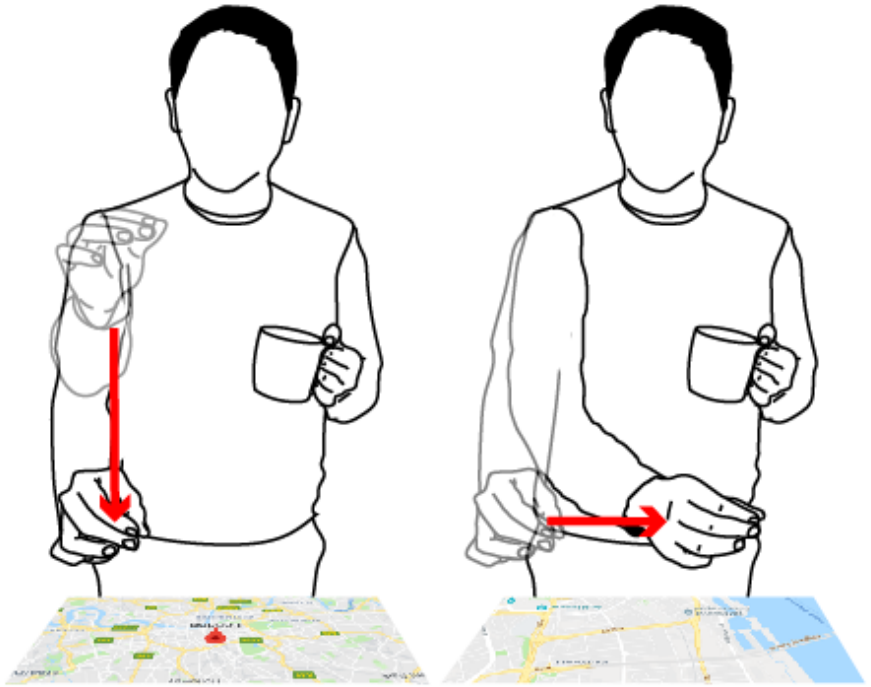
Volgrab Technique (Sekiguchi & Komuro, 2017)



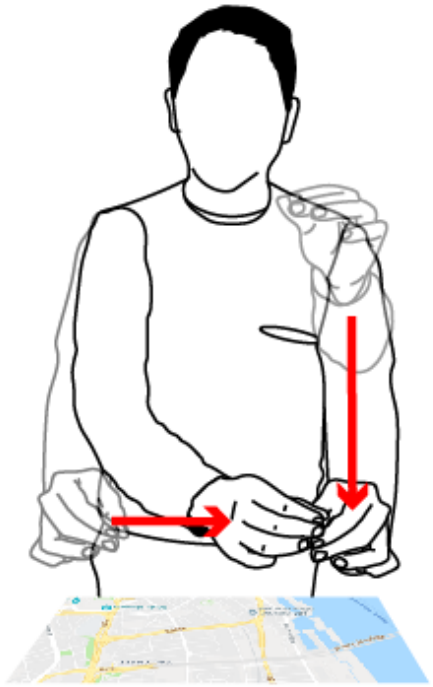
Joystick (Rate-based)

Joystick Technique (Stellmach et al, 2012)

Handedness

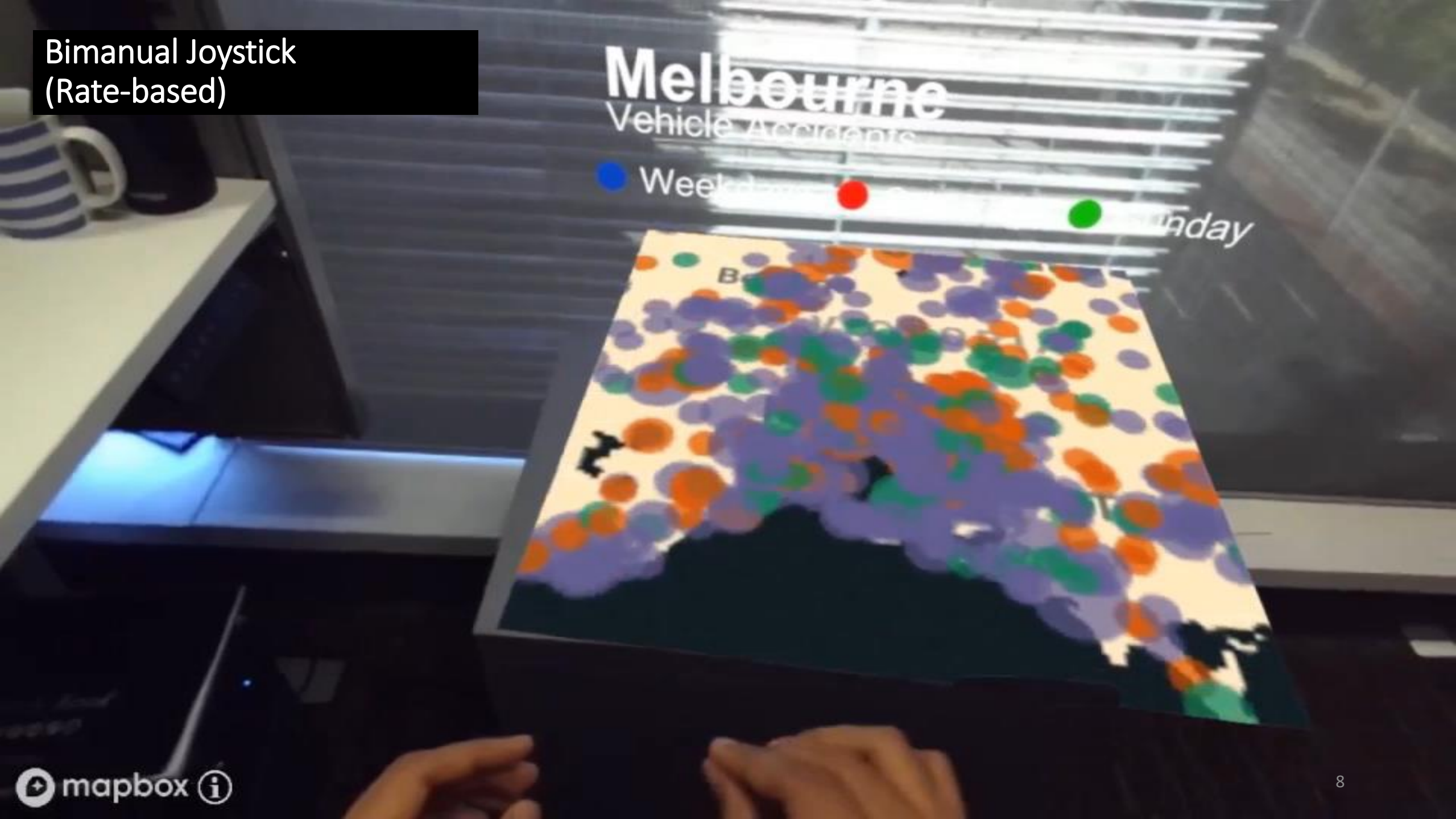


Unimanual Technique



Bimanual Technique

Bimanual Indirect Grab
(Position-based)
Melbourne
Vehicle
Mount Atkinson
mapbox


Bimanual Joystick
(Rate-based)
Melbourne
mapbox

Design Space Evaluation

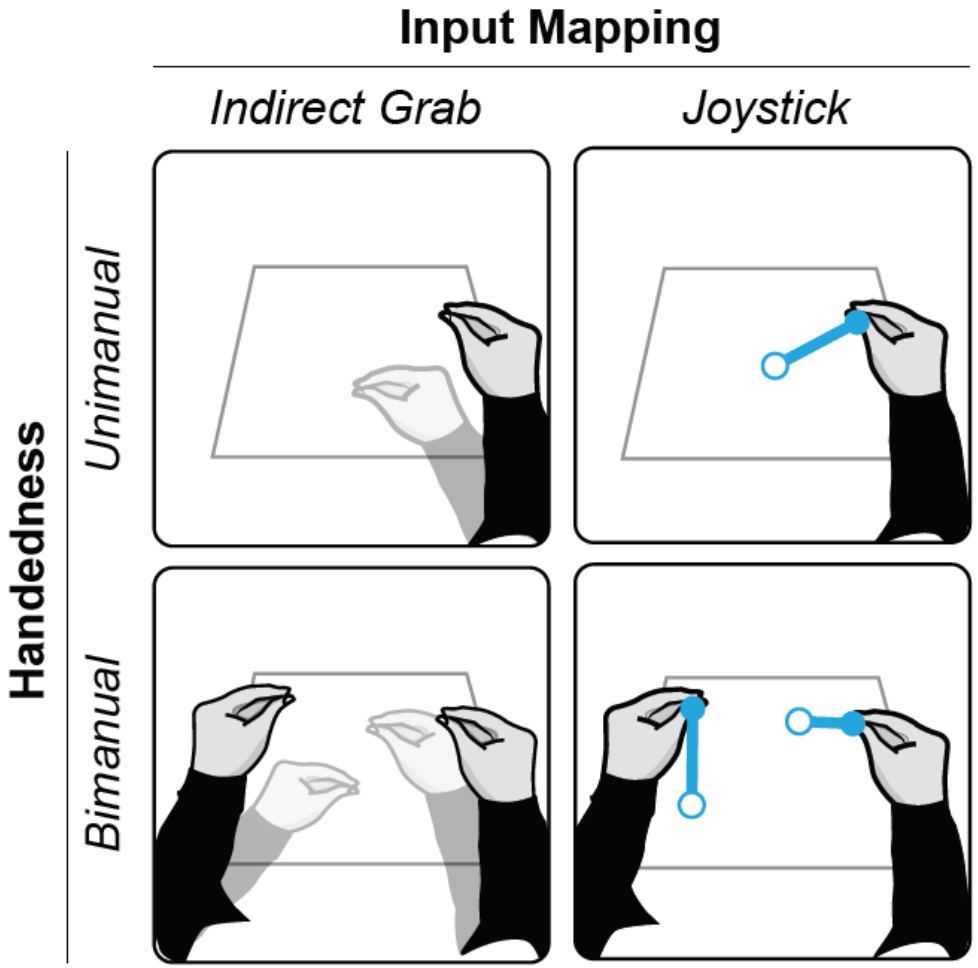
Factors

- Input Mapping
- Handedness
- Target Distance
- Target Direction

Measures

- Completion time
- Arm fatigue (Borg's RPE)
- User preference

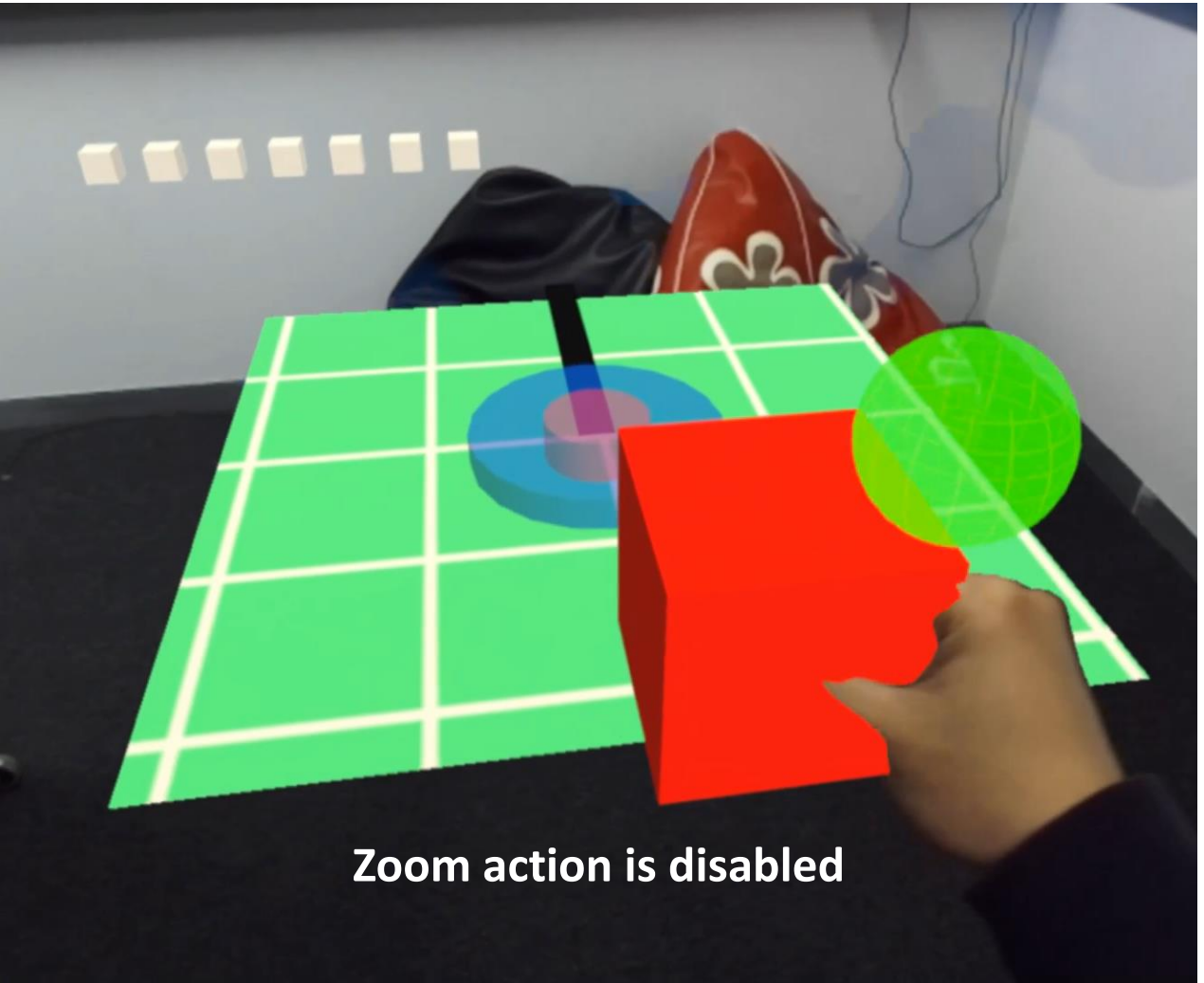
- **Participants**
  - 16 participants (13 M, 3 F)

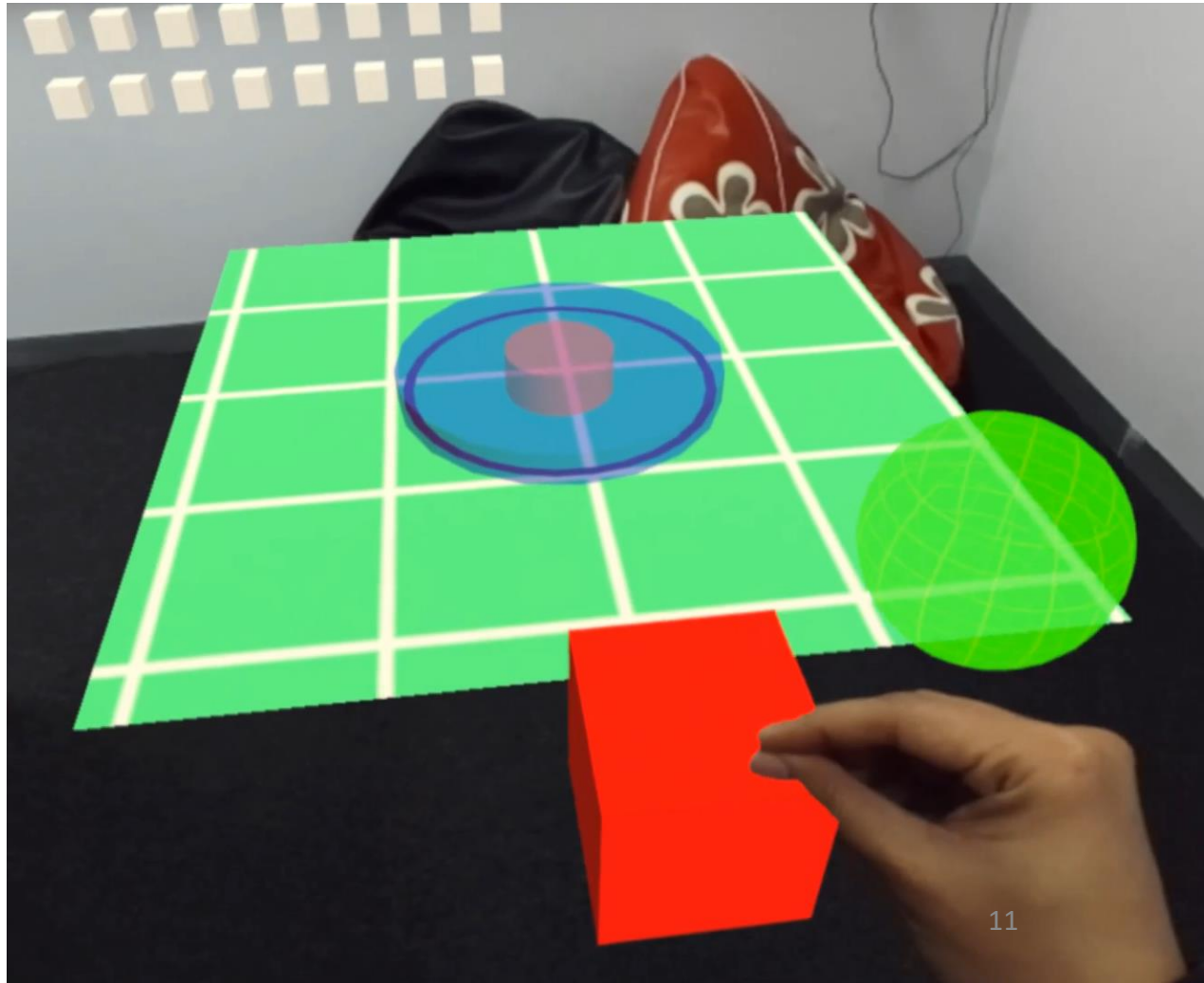


Tasks

Panning Only

Zooming



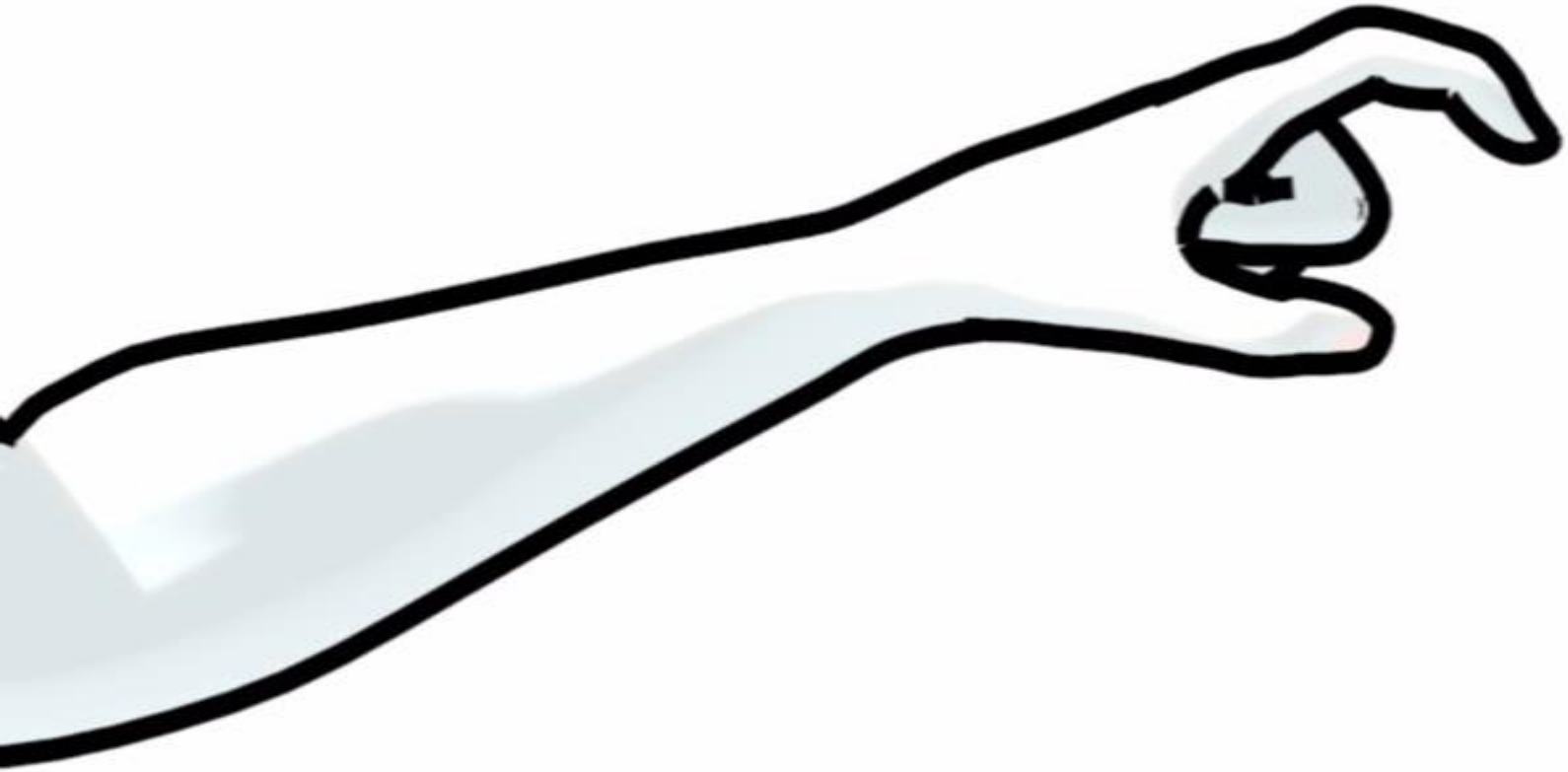


Apparatus (video see-through AR)

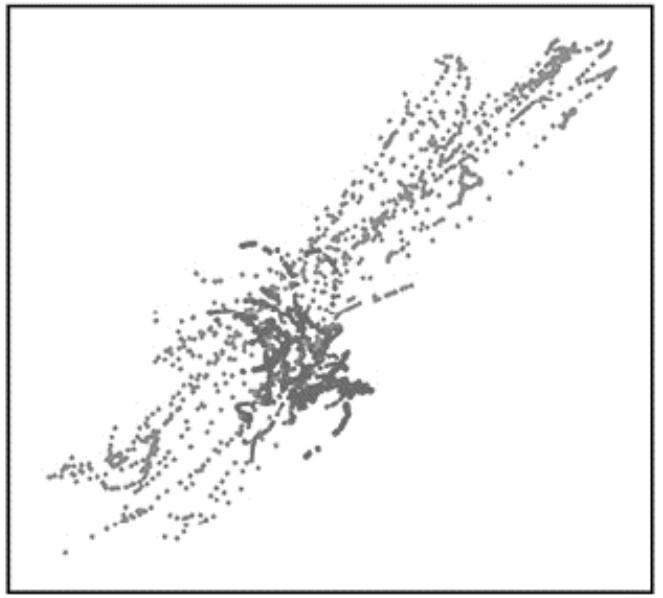
- HTC Vive + Zed Mini
- Leap Motion Hand Tracker Camera

Results Summary

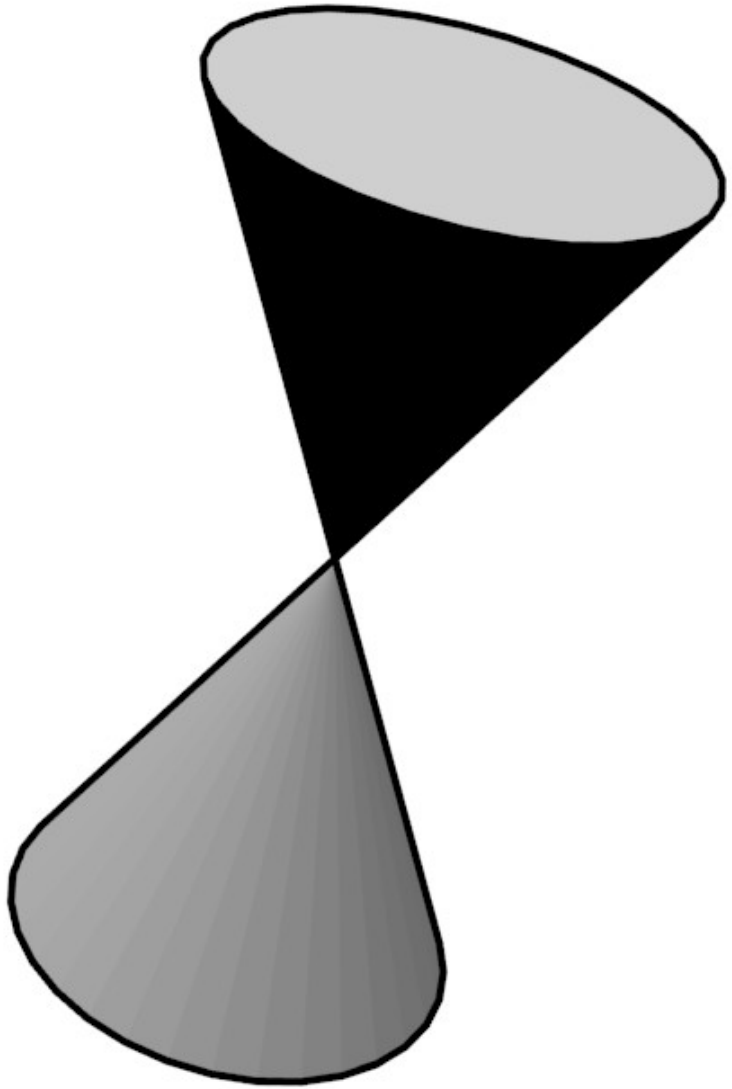
- **Indirect Grab** (position-based) is **faster** but **more fatiguing** than **Joystick** (rate-based)
- **Unimanual** is generally **faster** than **Bimanual**
- User preference is not conclusive
- Oblique hand movements in panning gestures



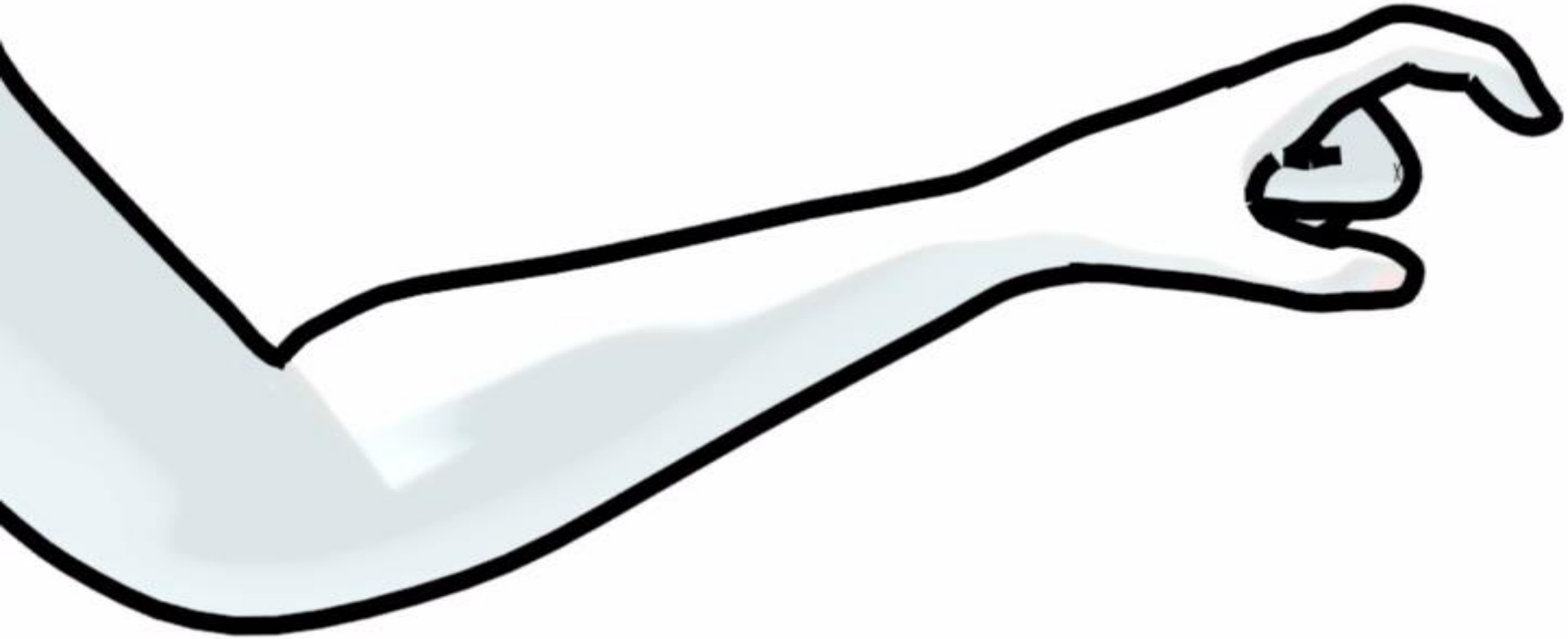
Hand positions (side view)
Unimanual Indirect Grab



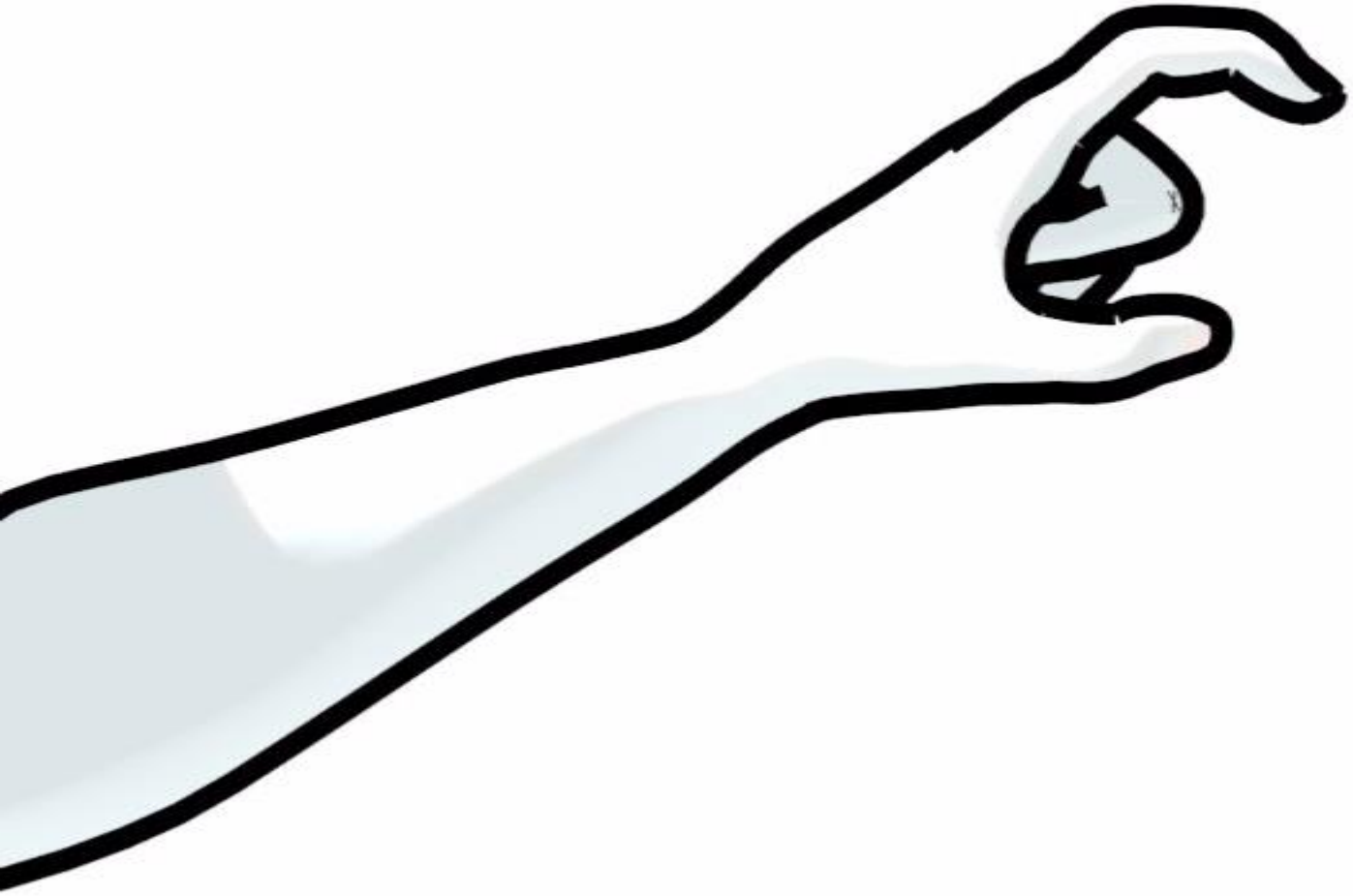
Unintended Zoom in **Panning Only Task**



Dual Cone



Panning Only Action



Integrated Panning and Zooming Action

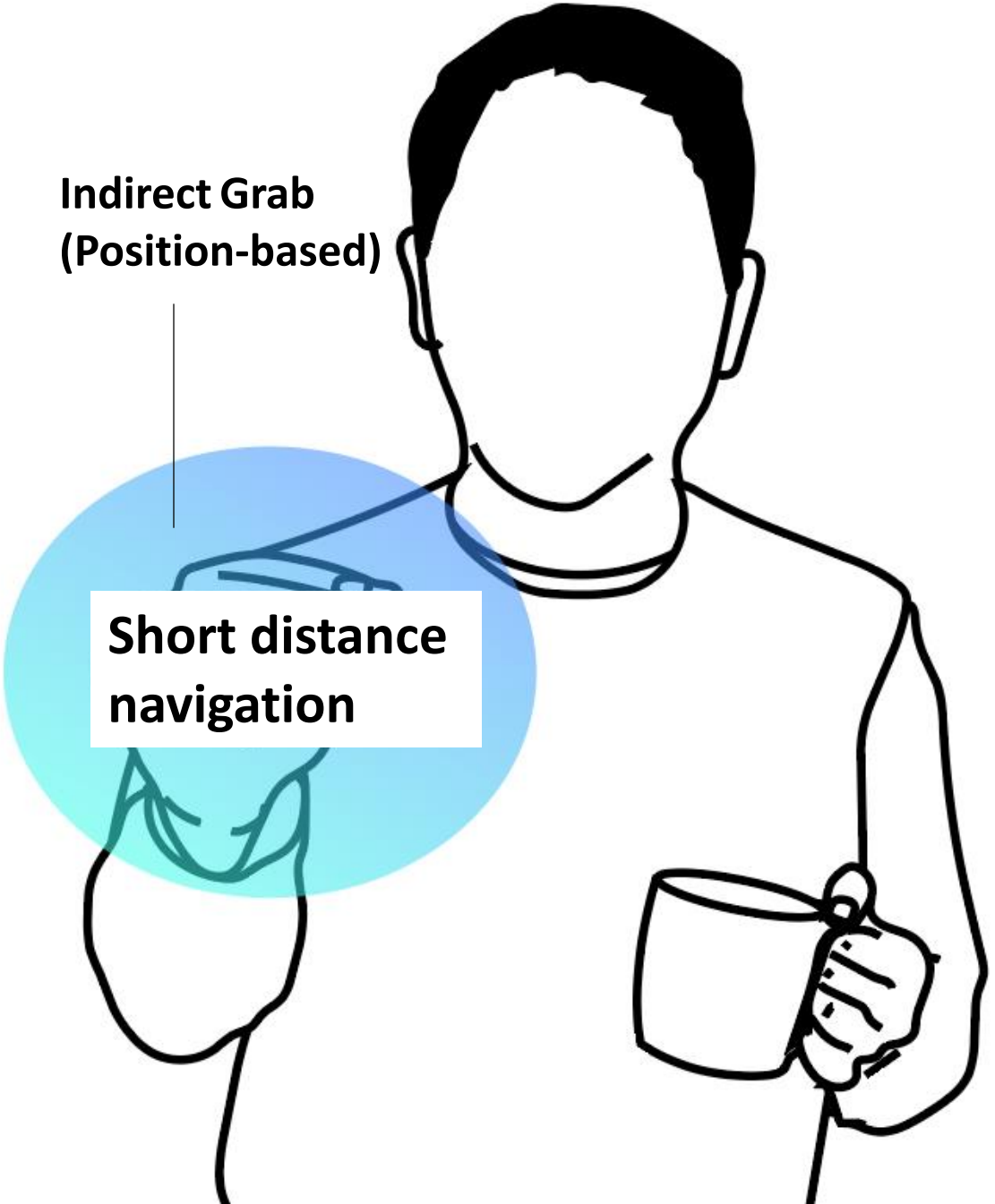
Hybrid Input Mappings

Goal: facilitate **short distance** and **long distance** navigation,
minimise fatigue

Approach: combine Indirect Grab (position-based) and Joystick (rate-based)

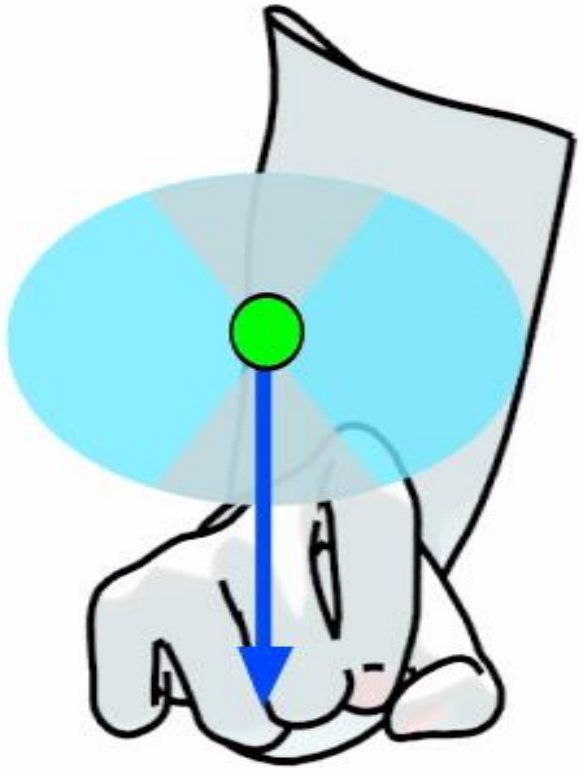
Joystick
(Rate-based)

Indirect Grab
(Position-based)



Long distance
navigation

Short distance
navigation



Pinching

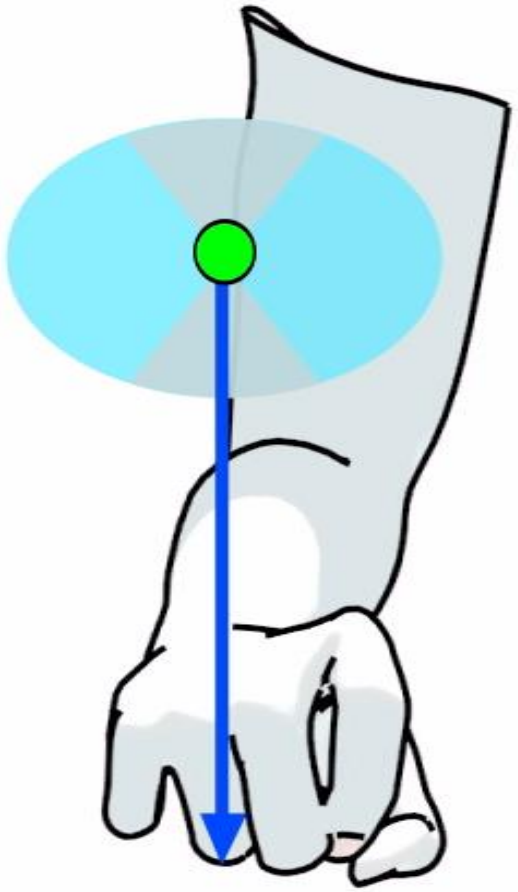
Indirect Grab
(Position-based)

Joystick (Rate-based)

Input Mapping Transition (Zoom in)

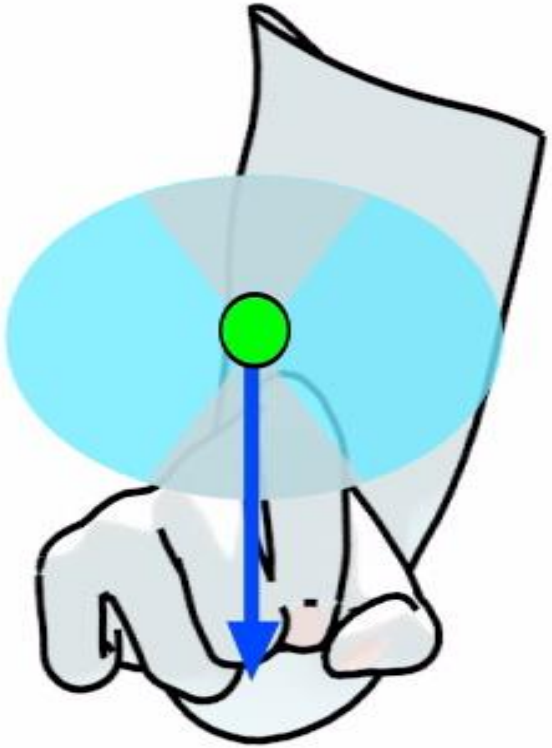
DiveZoom

Parallel zooming & panning



TerraceZoom

Sequential zooming & panning



User Study

Study Design

Techniques

- Indirect Grab
- Joystick
- DiveZoom
- TerraceZoom

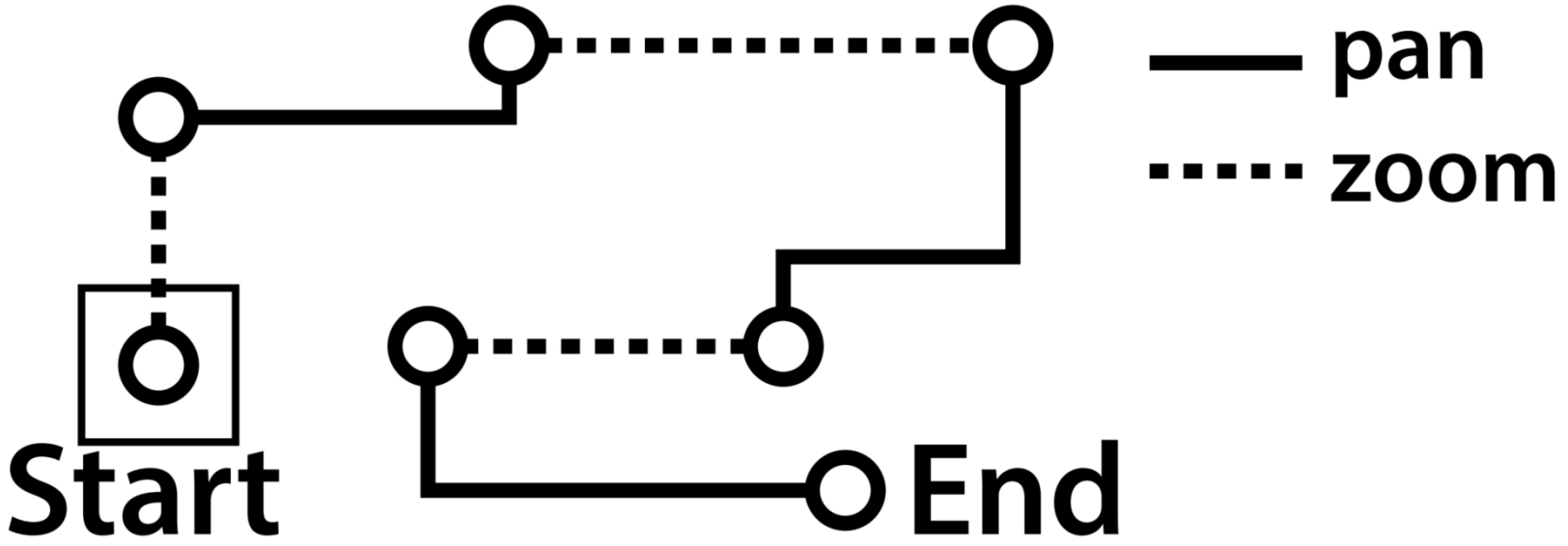
Measures

- Completion time
- Arm fatigue (Borg's RPE)
- User preference

Participants

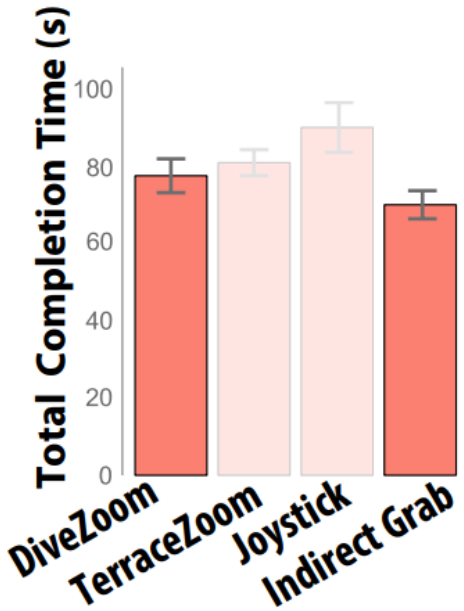
- 12 Participants (8 M, 4 F)

Navigation Task



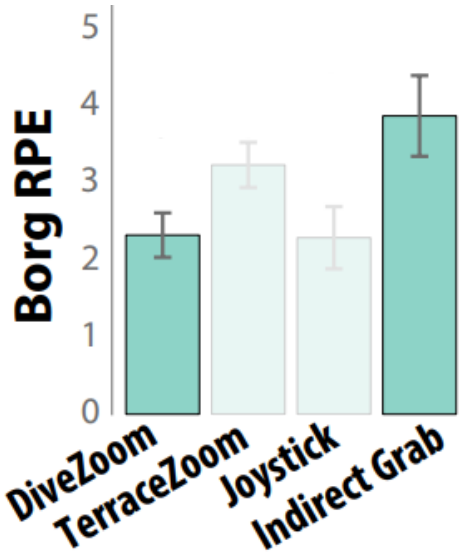
Total distance: ~ 3 km

Results: Performance



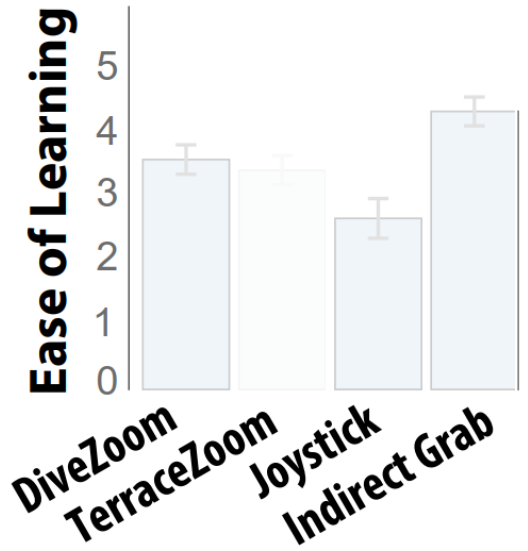
DiveZoom is as fast as Indirect Grab

Results: Perceived Fatigue



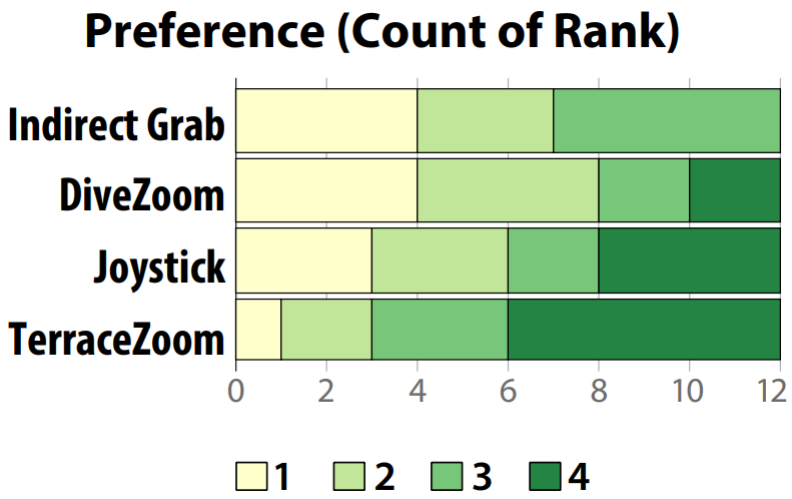
DiveZoom (weak fatigue) is less tiring than Indirect Grab (moderate fatigue).

Results: Ease of Learning



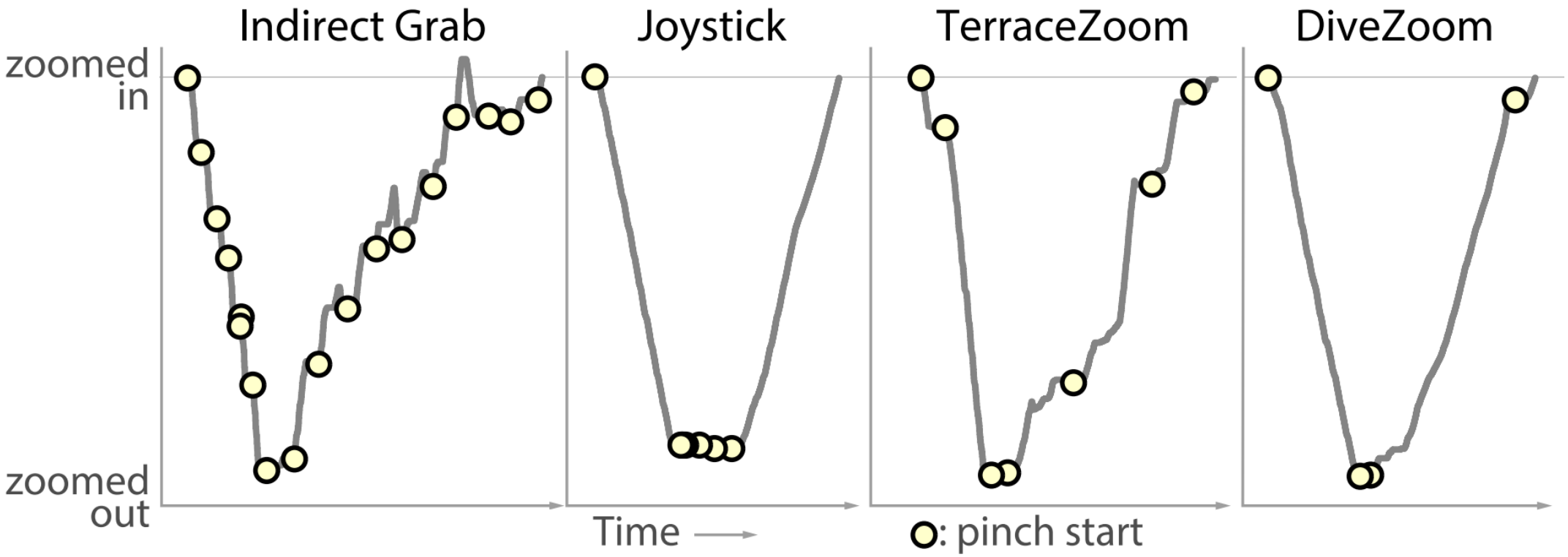
Indirect Grab is the easiest.
DiveZoom is easier than Joystick.

Results: Preference



Users prefer Indirect Grab and DiveZoom.

Conclusions



- Fatiguing
- Easiest to learn
- Fast

- Less-fatiguing
- Hard to learn
- Slow

- Fatiguing
- Hard to learn
- Slow

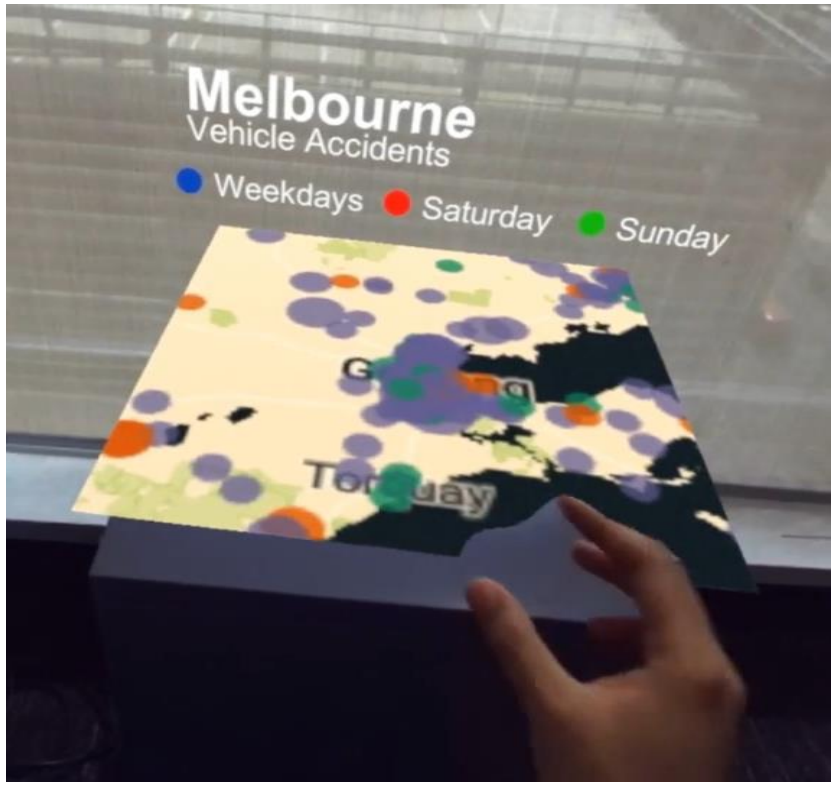
- Less-fatiguing
- Easy to learn
- Fast

Recommendations

Indirect Grab (Position-Based)

Short distance, short duration

DiveZoom (Hybrid)



Long distance, long duration

Thank you

ありがとうございました

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